

Diplexer MW Wavre 621 kHz & 300 kW, 540 kHz & 100 kW

Technical report

1. General

In 1992 the acceptance test of the MW diplexer in Wavre was carried out with the power of 350 kW ($m=1$ for 20 minutes) for 621 kHz and the power of 100 kW ($m=0.9$) for 540 kHz.

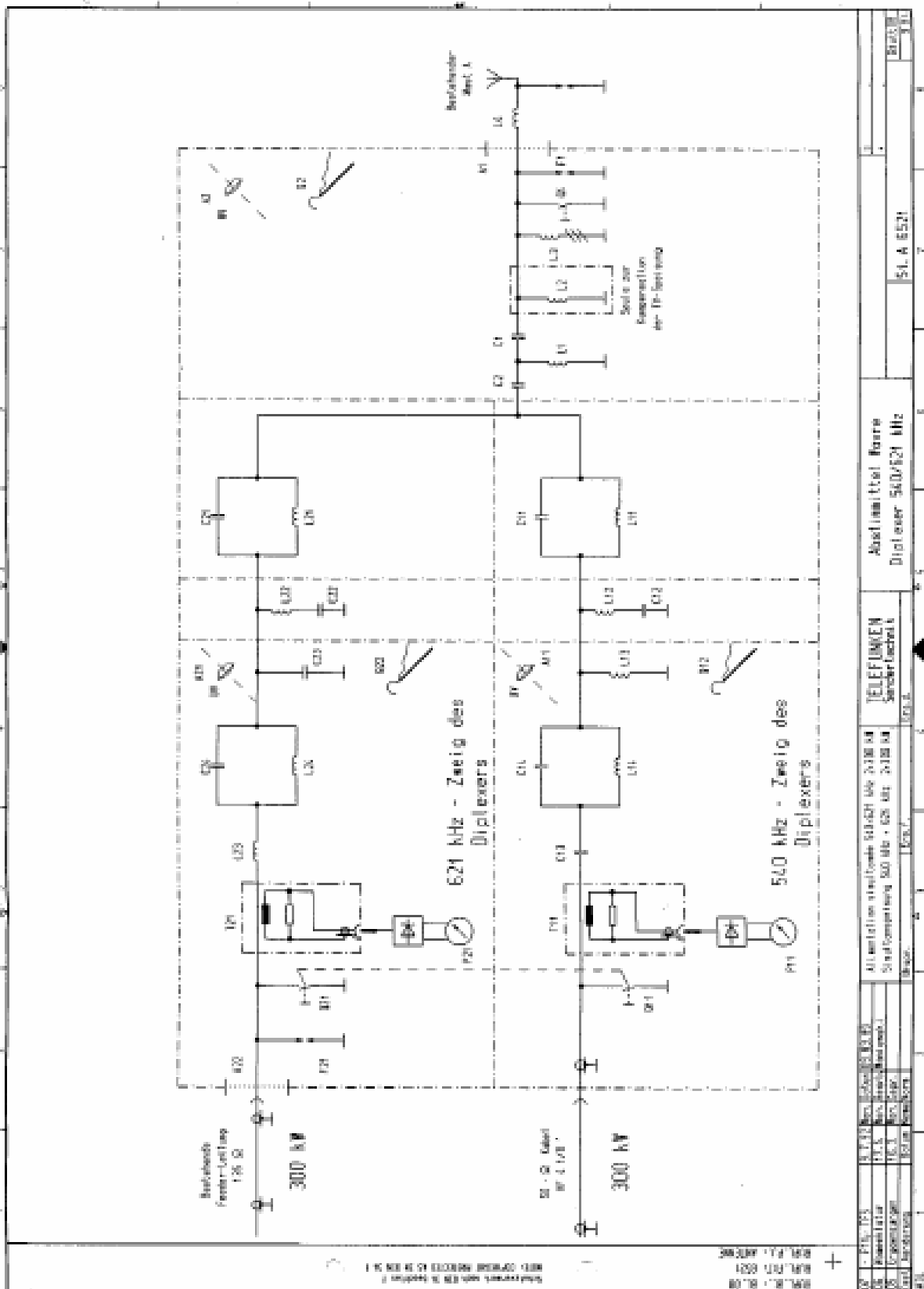
On the occasion of the use of the new TRAM 300 transmitter by TELEFUNKEN in 2002 flashes have been detected in the diplexer.

Comparing to the status of 1992 the antenna was modified. A $\lambda/4$ stub parallel to the base insulator used for TV cables was replaced by a coil L2. Hence it was necessary to adjust slightly the antenna tuning elements to obtain optimum standing wave ratios (SWR) for the two frequencies, which was done by VRT. At this time the transmitter for 621 kHz was operating with power less than 300 kW. No or very few flashes were reported.

In the week 44 of the year 2002, nearly exactly ten years after the acceptance tests, measurements and power tests have been carried out to search for the reasons for the flashes when operating with the new TRAM 300 transmitter.

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2. Design of diplexer



| | | | | | | | | | |
|----|---------|-------|-------|-----------------------------------------|--|--------------------------------------------|-----------|---|---|
| 07 | 170 175 | 17130 | 17130 | Auslieferungsauftrag 540/621 MHz 300 kW | | Abgabemittel Marke Diplexer 540/621 MHz | 51-A 6521 | 7 | 1 |
| 08 | 17130 | 17130 | 17130 | 540/621 MHz 300 kW | | | | | |
| 09 | 17130 | 17130 | 17130 | 540/621 MHz 300 kW | | | | | |
| 10 | 17130 | 17130 | 17130 | 540/621 MHz 300 kW | | | | | |
| 11 | 17130 | 17130 | 17130 | 540/621 MHz 300 kW | | | | | |
| 12 | 17130 | 17130 | 17130 | 540/621 MHz 300 kW | | | | | |
| 13 | 17130 | 17130 | 17130 | 540/621 MHz 300 kW | | | | | |

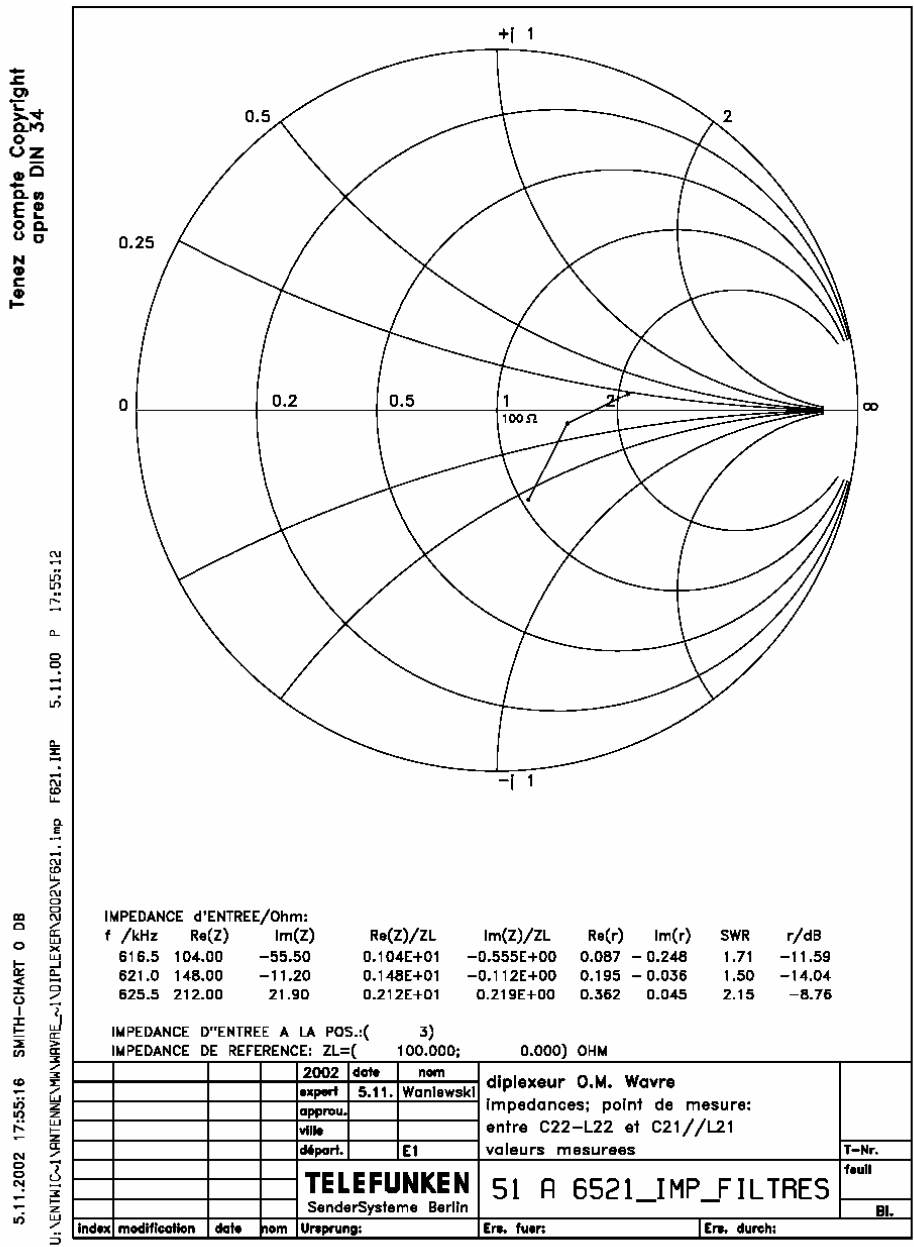
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3. Measurements

The following measurements have been carried out:

3.1 Measuring of impedance in the branch of 621 kHz at the point where the series filter L22-C22 is connected to the rejection filter L21//C21 for the centre frequency and the frequencies +/- 4.5 kHz. This point was chosen because the highest voltages occur between L22 and C22 of the series filter.

Drawing 51 A 6521_IMP_FILTERS shows the impedances with reference to 100 ohms:

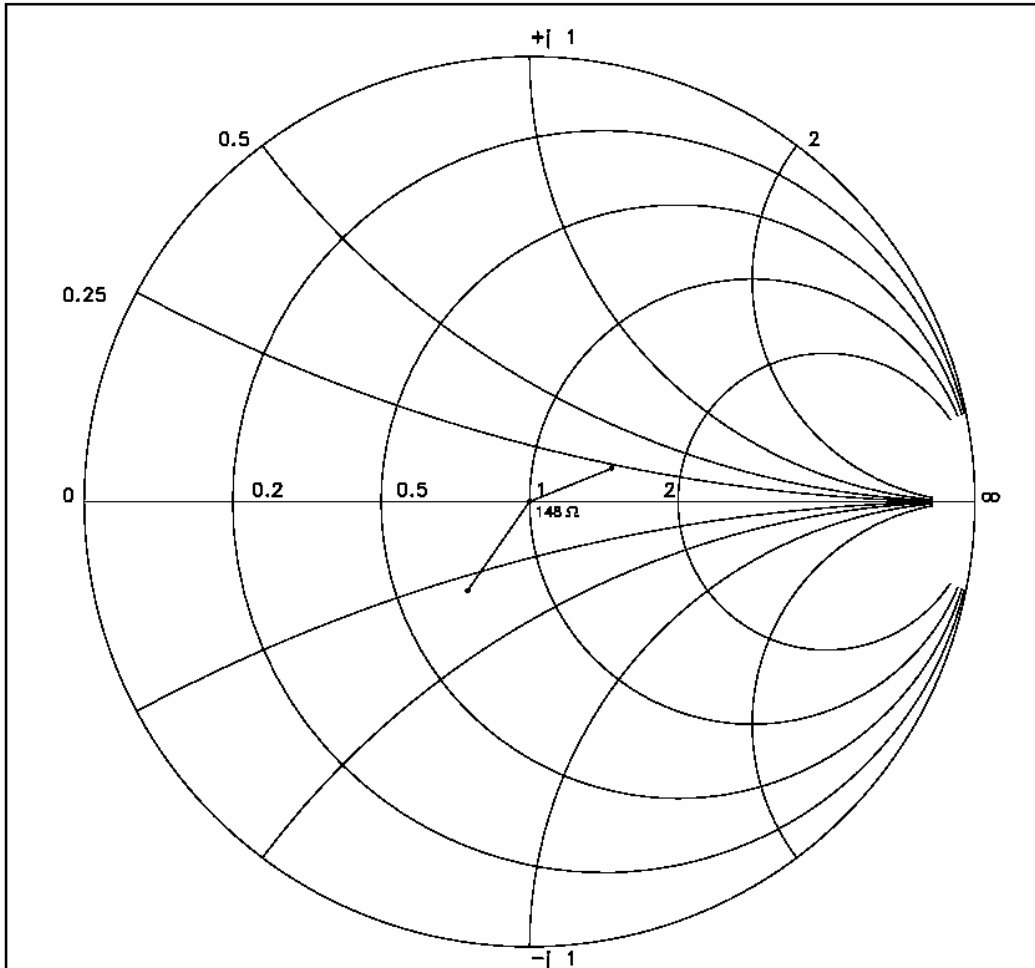


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Drawing 51 A 6521_TOS_FILTRES shows the standing wave ratio with reference to the impedance of the centre frequency:

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5.11.2002 18:01:37 SMITH-CHART 0 DB
U:\ENTR\IC-1\ARNTENNE\MW\WAVRE_~\NDI\PLEXER\2002\F621_imp F621_imp 5.11.00 P 18:01:32



| IMPEDANCE d'ENTREE/Ohm: | | | | | | | | |
|-------------------------|--------|--------|-----------|------------|--------|--------|------|--------|
| f /kHz | Re(Z) | Im(Z) | Re(Z)/ZL | Im(Z)/ZL | Re(r) | Im(r) | SWR | r/dB |
| 616.5 | 104.00 | -44.30 | 0.703E+00 | -0.299E+00 | -0.139 | -0.200 | 1.65 | -12.25 |
| 621.0 | 148.00 | 0.00 | 0.100E+01 | 0.147E-04 | 0.000 | 0.000 | 1.00 | 102.55 |
| 625.5 | 212.00 | 33.10 | 0.143E+01 | 0.224E+00 | 0.185 | 0.075 | 1.50 | -14.01 |

IMPEDANCE D'ENTREE A LA POS.:(3)
IMPEDANCE DE REFERENCE: ZL=(148.000; 0.000) OHM ZI= -11.200 Ohm

| | | | | | | | |
|-------|--------------|------|----------------------|-----------|-----------------------|-------------------------------------------------------------------------------------------------------------------------|---------|
| | | | 2002 | date | nom | diplexeur O.M. Wavre taux d'onde stationnaire TOS; point de mesure: entre C22-L22 et C21//L21 valeurs mesurees | |
| | | | expert | 5.11. | Waniewski | | T-Nr. |
| | | | approu. | | | | feuille |
| | | | ville | | | | Bl. |
| | | | départ. | | E1 | | |
| | | | TELEFUNKEN | | 51 A 6521_TOS_FILTRES | | |
| | | | SenderSysteme Berlin | | | | |
| index | modification | date | nom | Ursprung: | Ers. fuer: | Ers. durch: | |

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Conclusions and remarks:

- Due to the modification of the antenna the change of impedance at the point of the series filter L22-C22 causes an increase of voltage by 5 % across the series filter.
- The bandwidth for the frequencies +/- 4.5 kHz remains nearly the same compared to the situation in 1992.

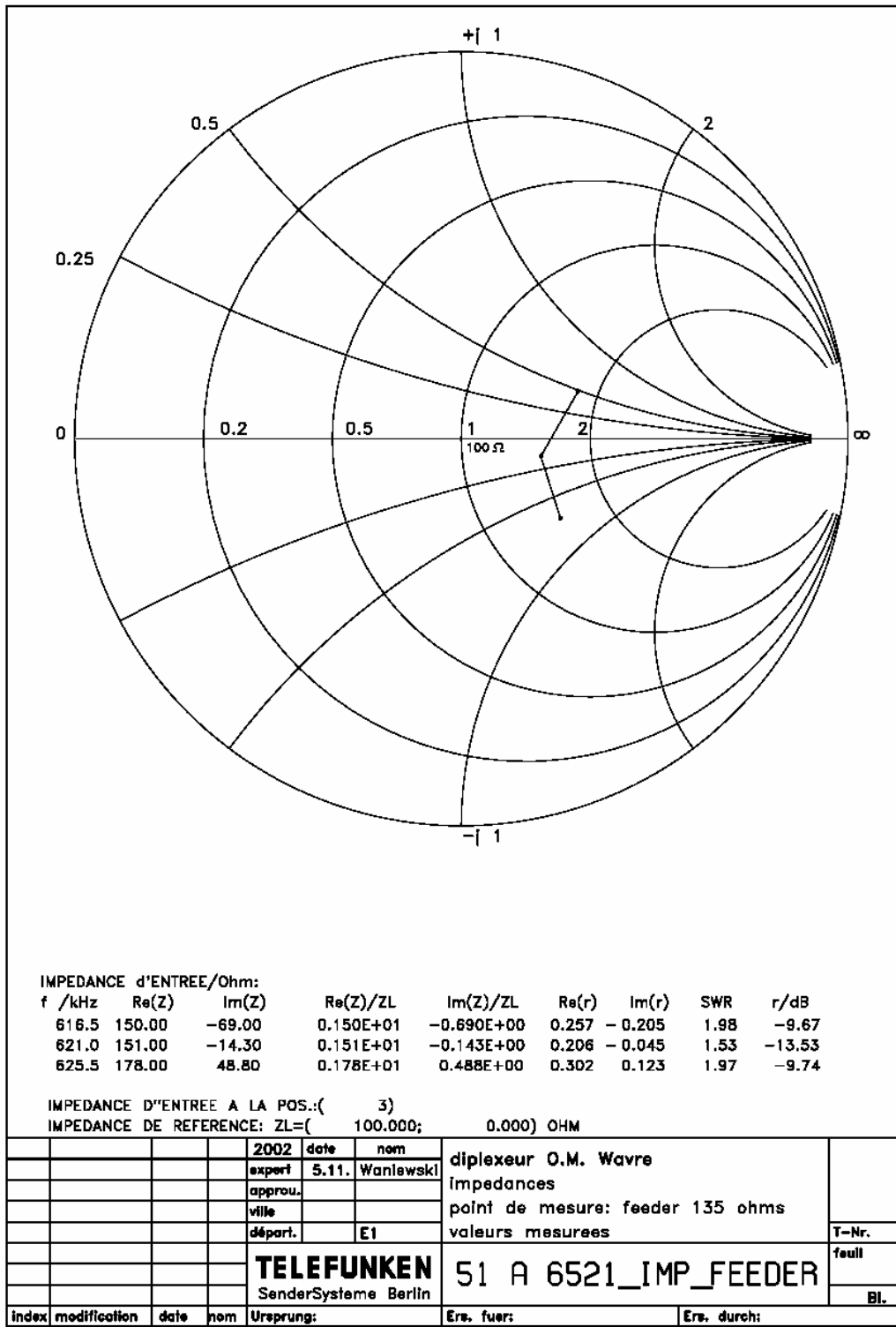
3.2 Measuring of impedance in the branch of 621 kHz at the point where the feeder line is connected to L23 for the centre frequency and the frequencies +/- 4.5 kHz.

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Drawing 51 A 6521_IMP_FEEDER shows the impedances with reference to 100 ohms:

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5.11.2002 17:43:27 SMITH-CHART 0 DB
U:\ENTR\IC-1\NANTENNE\MW\WAVRE_1\DIPLXERY2002\F621.imp F621_IMP 5.11.00 P 17:42:17

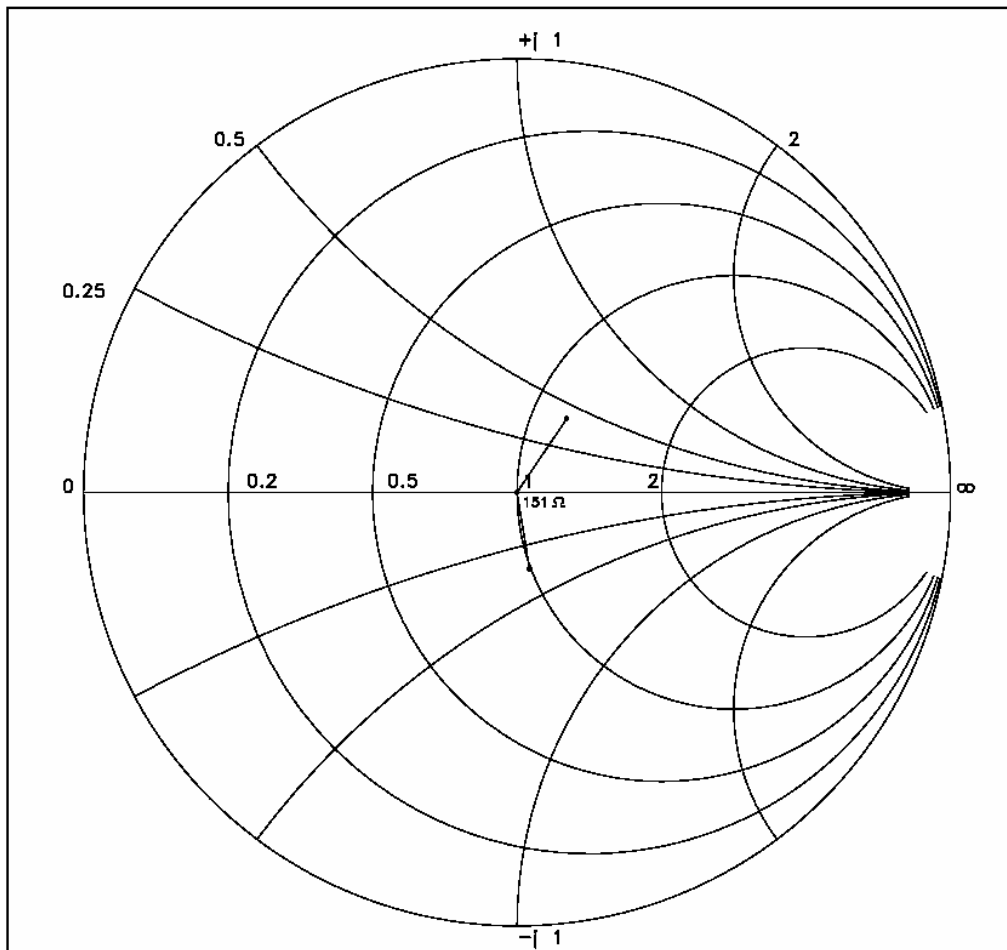


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Drawing 51 A 6521_TOS_FEEDER shows the standing wave ratio with reference to the impedance of the centre frequency.

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5.11.2002 17:36:42 SMITH-CHART 0 DB
U:\CENTRIC-1\PROJET\MW\WAVRE_~1\NDIPLEXER\2002\F621.i.mp F621.i.mp 5.11.00 P 17:32:54



IMPEDANCE d'ENTREE/Ohm:

| f /kHz | Re(Z) | Im(Z) | Re(Z)/ZL | Im(Z)/ZL | Re(r) | Im(r) | SWR | r/dB |
|--------|--------|--------|-----------|------------|-------|--------|------|--------|
| 616.5 | 150.00 | -54.70 | 0.993E+00 | -0.362E+00 | 0.029 | -0.176 | 1.44 | -14.95 |
| 621.0 | 151.00 | 0.00 | 0.100E+01 | 0.150E-04 | 0.000 | 0.000 | 1.00 | 102.36 |
| 625.5 | 178.00 | 63.10 | 0.118E+01 | 0.418E+00 | 0.115 | 0.170 | 1.52 | -13.77 |

IMPEDANCE D'ENTREE A LA POS.:(3)

IMPEDANCE DE REFERENCE: ZL=(151.000; 0.000) OHM ZI= -14.300 Ohm

| | | | | | | | |
|-------|--------------|------|----------------------|-----------|----------------------|----------------------------------|-------|
| | | | 2002 | date | nom | diplexeur O.M. Wavre | |
| | | | expert | 5.11. | Waniewski | taux d'onde stationnaire TOS | |
| | | | approu. | | | point de mesure: feeder 135 ohms | |
| | | | ville | | | valeurs mesurees | T-Nr. |
| | | | départ. | | E1 | | feuil |
| | | | TELEFUNKEN | | 51 A 6521_TOS_FEEDER | | Bl. |
| | | | SenderSysteme Berlin | | | | |
| index | modification | date | nom | Ursprung: | Ers. fuer: | Ers. durch: | |

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Conclusions and remarks:

- The bandwidth for the frequencies +/- 4.5 kHz remains nearly the same compared to the situation in 1992.

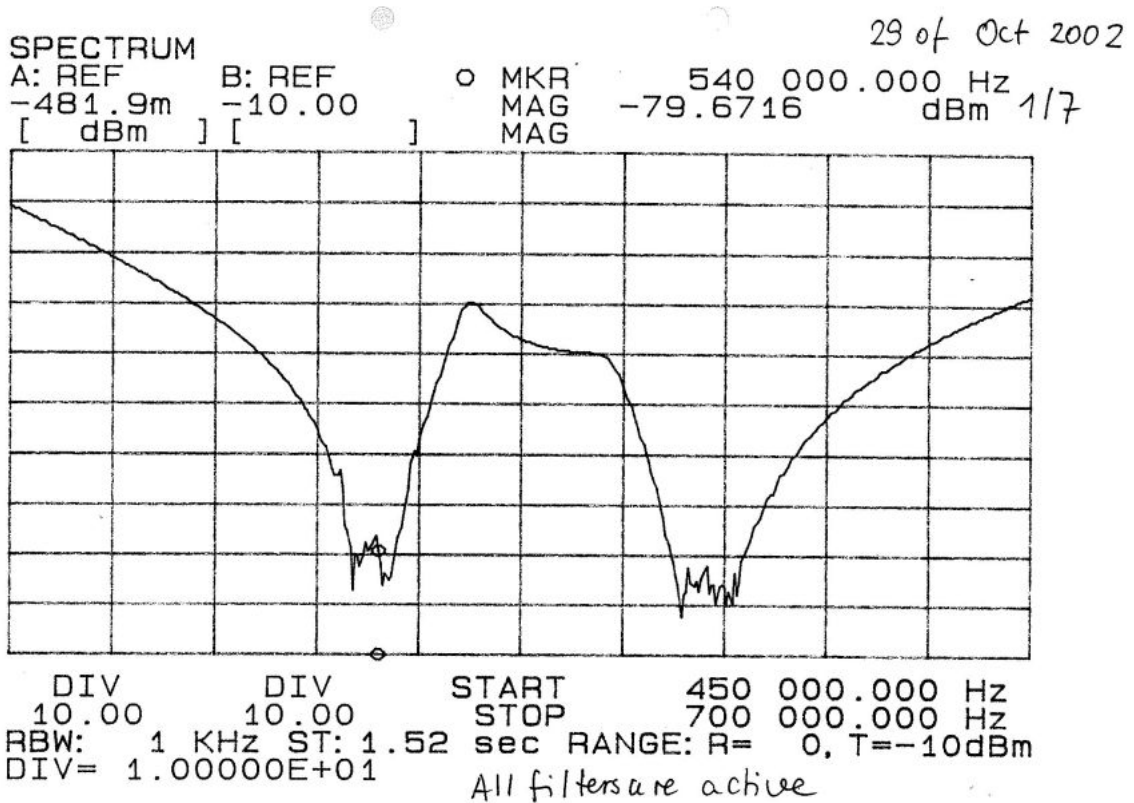
3.3 Measuring of the filters (7 plots)

The diplexer was disconnected from

- the 50 ohms cable on the 540 kHz side,
- the 135 feeder line on the 621 kHz side, and
- the antenna including obstruction light coil

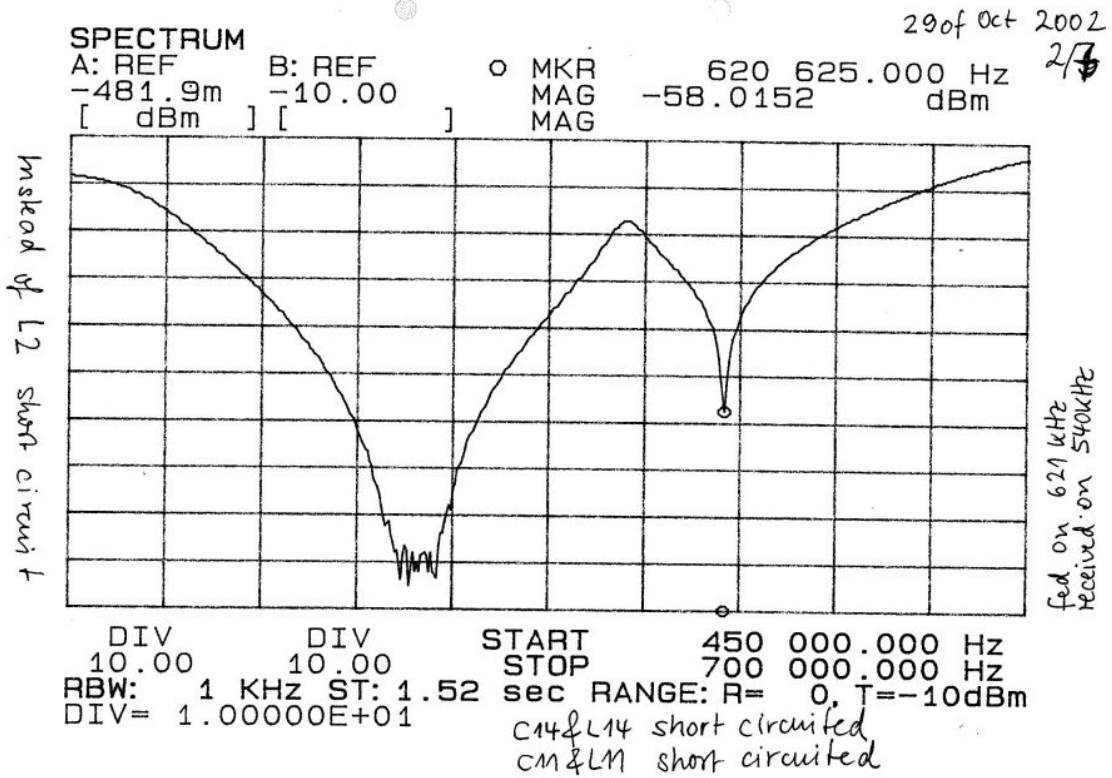
The signal was fed on the side of 621 kHz and received on the side of 540 kHz.

- Plot 1 of 7 shows the spectrum when all filters are active.

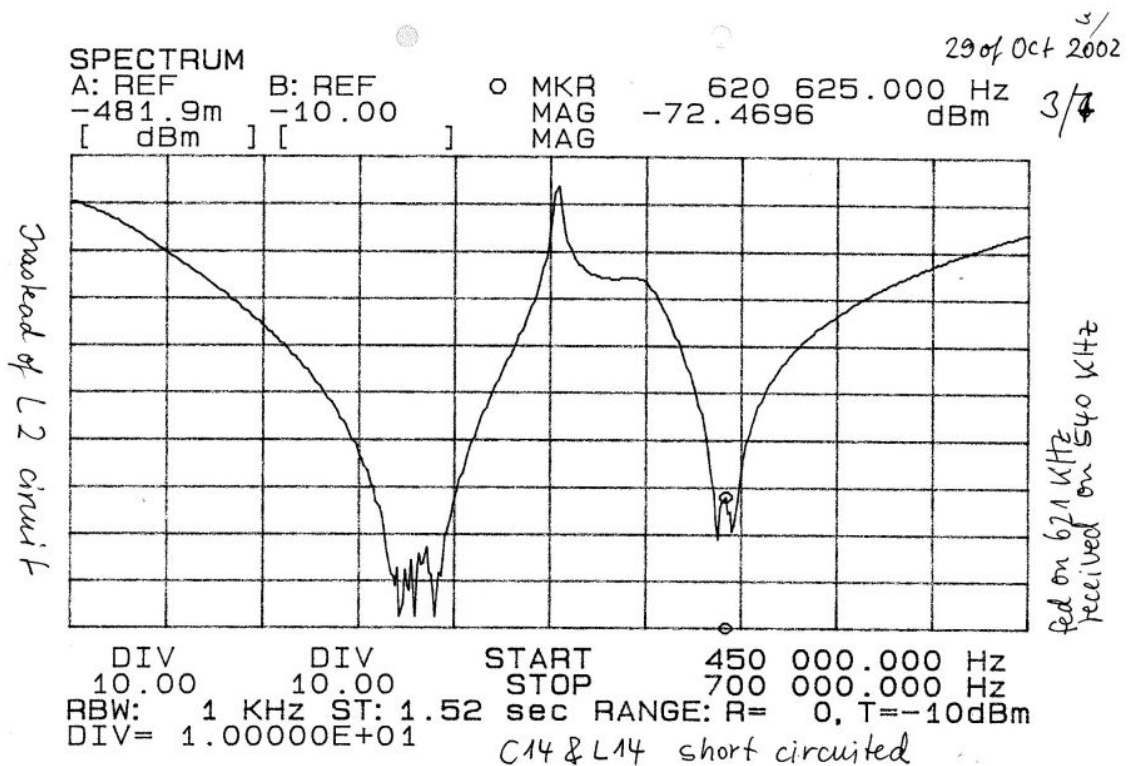


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- Plot 2 of 7 shows the spectrum when all filters except C14&L14 and C11&L11 are active.

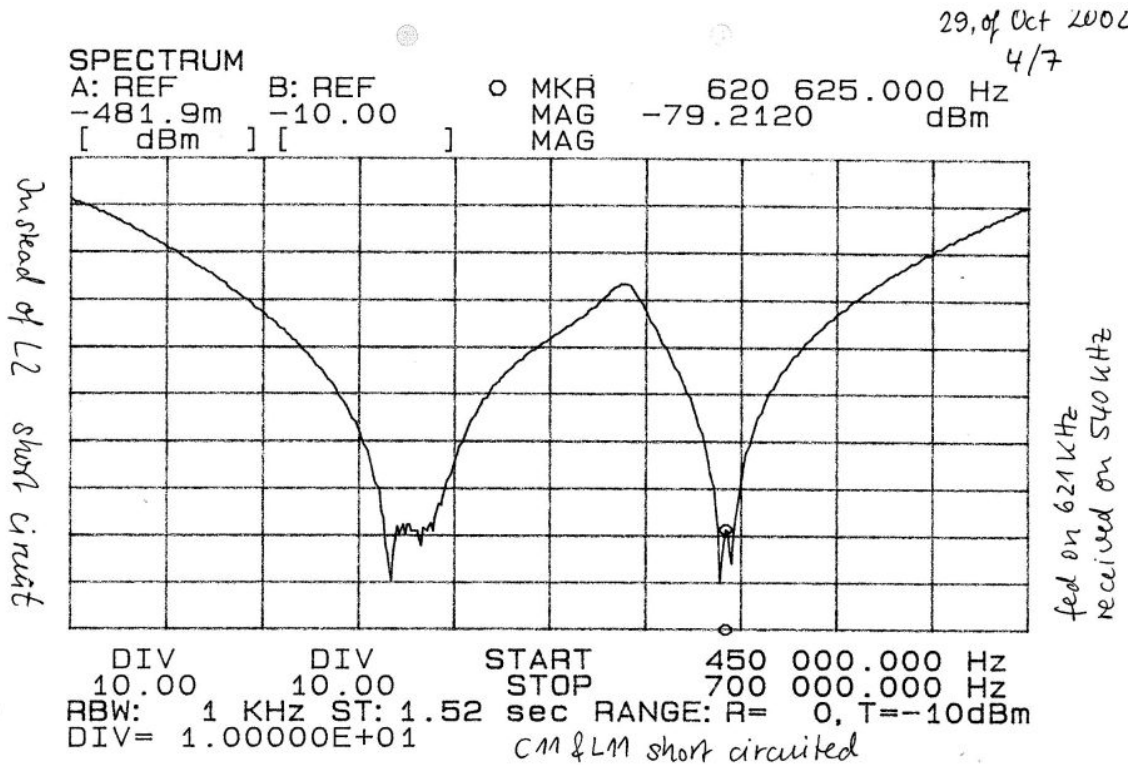


- Plot 3 of 7 shows the spectrum when all filters except C14&L14 are active.

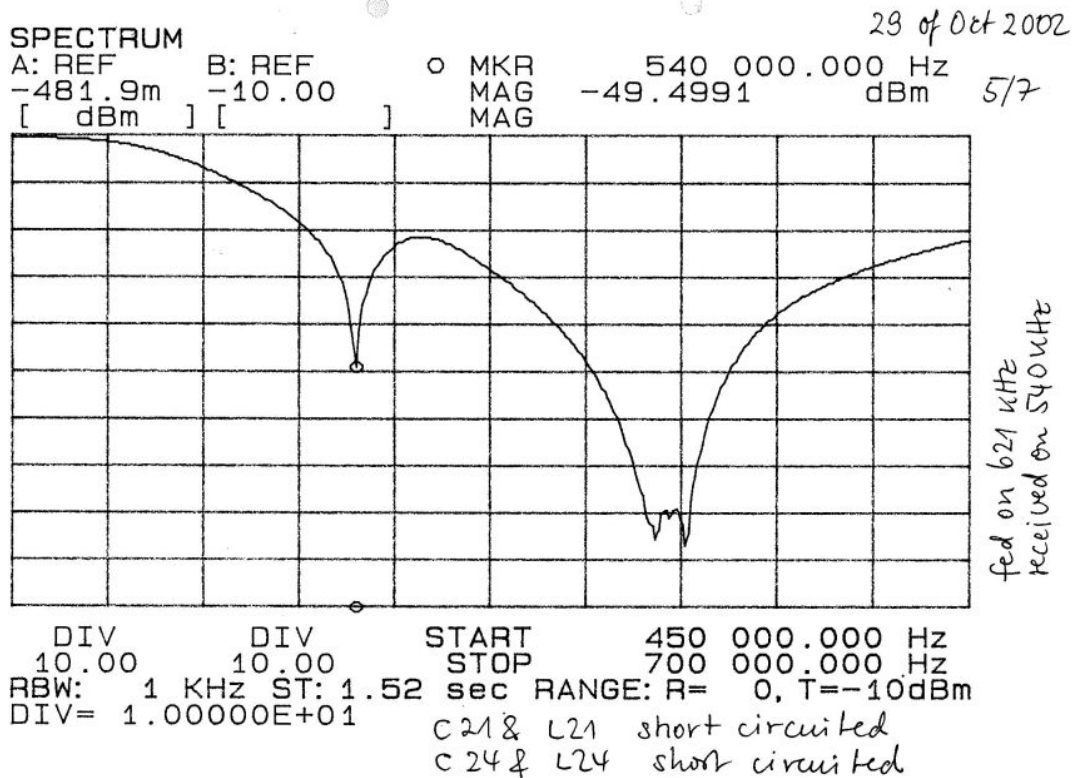


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- Plot 4 of 7 shows the spectrum when all filters except C11&L11 are active.

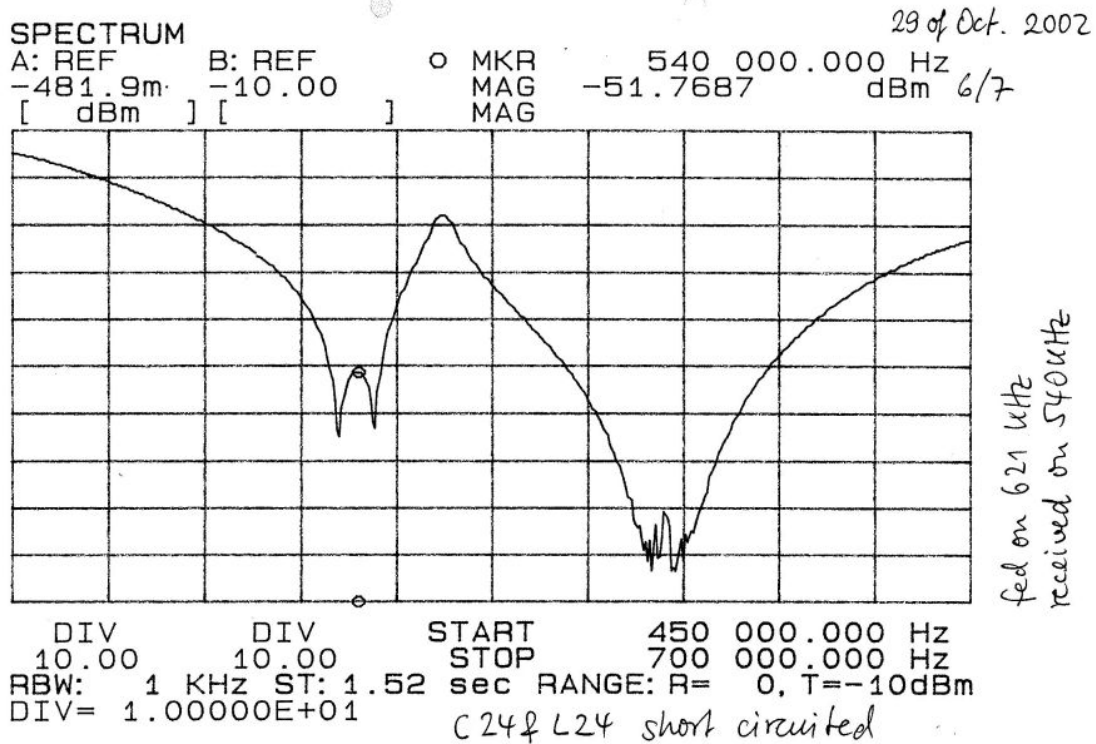


- Plot 5 of 7 shows the spectrum when all filters except C21&L21 and C24&L24 are active.

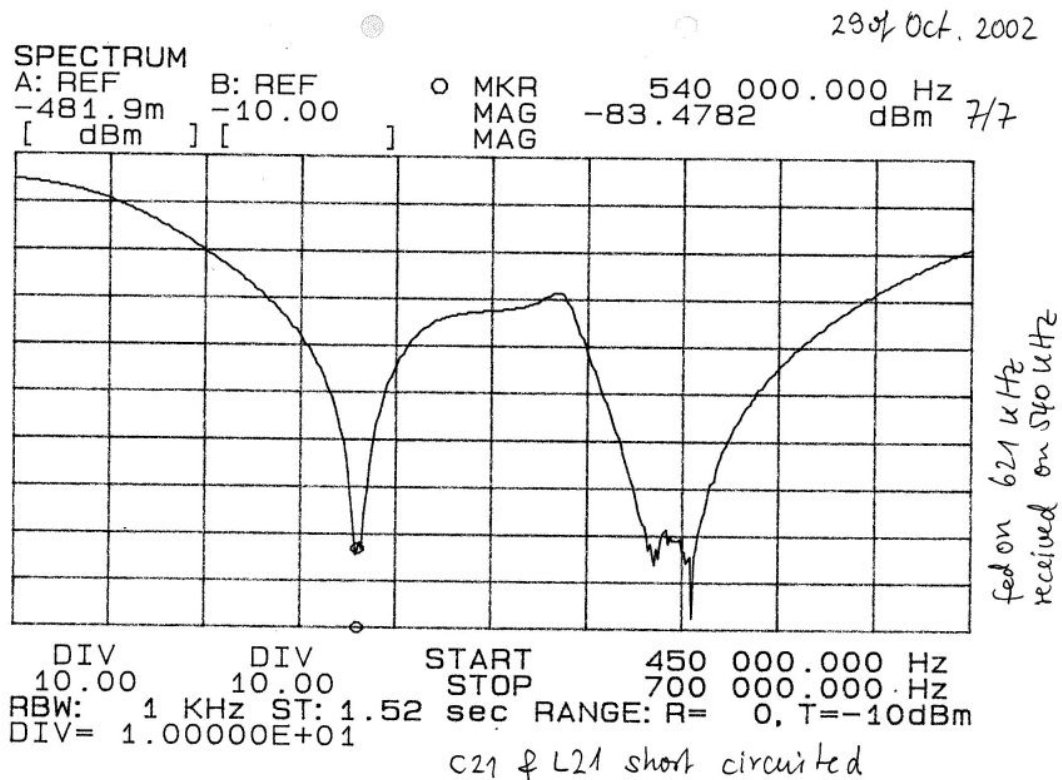


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- Plot 6 of 7 shows the spectrum when all filters except C24&L24 are active.



- Plot 7 of 7 shows the spectrum when all filters except C21&L21 are active.



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Conclusions and remarks:

- The plots show that the tuning of the filters represent the optimum and that it is not changed compared to the situation in 1992.

4. Power tests

During power tests with full power and modulation it was discovered that the flashes occur on the end of the centre tube of coil L22. "Sharp" edges at this point lead to high concentrations of field strength, which causes the flashes.

Conclusions and remarks:

- Obviously due to voltages which are now 5 % higher than in 1992, flashes continuously occur at this point. It could be that occasional flashes in the diplexer reported earlier could have had the same reason.
- To remedy the situation the end of the tube was provided with a graphite ball of diameter 45 mm. No further flashes occurred.